WHAT IS CLAIMED IS:

1. A process for producing an ethylene/α-olefin/non-conjugated polyene copolymer comprising copolymerizing ethylene, an α-olefin and a non-conjugated polyene in a hydrocarbon solvent with use of a transition metal compound catalyst, and removing the unreacted monomers and the hydrocarbon solvent from the copolymer solution without removing the catalyst residue, wherein the copolymerization is carried out at a polymerization temperature of 100°C or above and a polymerization pressure of 2.7 MPa or above in a manner such that the non-conjugated polyene concentration in the polymerization solution is less than the maximum non-conjugated polyene concentration Cmax (mol/L) indicated below:

Cmax = 0.050 (mol/L) when the copolymer has an iodine value (IV) of 9.0 g/100 g to less than 17.0 g/100 g; or

Cmax = 0.104 (mol/L) when the copolymer has an iodine value (IV) of 17.0 g/100 g or above.

2. A process for producing an ethylene/α-olefin/non-conjugated polyene copolymer comprising copolymerizing ethylene, an α-olefin and a

non-conjugated polyene in a hydrocarbon solvent with use of a transition metal compound catalyst, and removing the unreacted monomers and the hydrocarbon solvent from the copolymer solution without removing the catalyst residue, wherein the copolymerization is carried out at a polymerization temperature of 100°C or above and a combined vapor pressure of the hydrocarbon solvent and the unreacted monomers of 2.7 MPa or above in a manner such that the non-conjugated polyene concentration in the polymerization solution is less than the maximum non-conjugated polyene concentration Cmax (mol/L) indicated below:

Cmax = 0.050 (mol/L) when the copolymer has an iodine value (IV) of 9.0 g/100 g to less than 17.0 g/100 g; or

Cmax = 0.104 (mol/L) when the copolymer has an iodine value (IV) of 17.0 g/100 g or above.

3. A process for producing an ethylene/α-olefin/non-conjugated polyene copolymer comprising copolymerizing ethylene, an α-olefin and a non-conjugated polyene in a hydrocarbon solvent with use of a transition metal compound catalyst, and removing the unreacted monomers and the hydrocarbon solvent from the copolymer solution without removing the catalyst residue, wherein the copolymerization is carried out at a

polymerization temperature T (K) and a polymerization pressure P_a (MPa) in a manner such that the non-conjugated polyene concentration in the polymerization solution is less than the maximum non-conjugated polyene concentration Cmax (mol/L) indicated below:

Cmax = 0.050 × Iodine Value (IV) × $10^{\{12.25+1.16\times\log P^a+5.37\times\log(1/T)\}}$ when the polymerization temperature is less than 353.16 K (80°C);

Cmax = 0.050 × Iodine Value (IV) × $10^{\{11.88+1.23\times\log P^a+5.23\times\log(1/T)\}}$ when the polymerization temperature is from 353.16 K (80°C) to less than 393.16 K (120°C); or

Cmax = 0.050 × Iodine Value (IV) × $10^{\{19.02+1.61\times\log P^a+8.02\times\log(1/T)\}}$ when the polymerization temperature is 393.16 K (120°C) or above.

4. A process for producing an ethylene/α-olefin/non-conjugated polyene copolymer comprising copolymerizing ethylene, an α-olefin and a non-conjugated polyene in a hydrocarbon solvent with use of a transition metal compound catalyst, and removing the unreacted monomers and the hydrocarbon solvent from the copolymer solution without removing the catalyst residue, wherein the copolymerization is carried out at a

polymerization temperature T (K) and a combined vapor pressure P_b (MPa) of the hydrocarbon solvent and the monomers in a manner such that the non-conjugated polyene concentration in the polymerization solution is less than the maximum non-conjugated polyene concentration Cmax (mol/L) indicated below:

Cmax = 0.050 × Iodine Value (IV) × $10^{\{12.25+1.16\times\log P^b+5.37\times\log(1/T)\}}$ when the polymerization temperature is less than 353.16 K (80°C);

Cmax = 0.050 × Iodine Value (IV) × $10^{\{11.88+1.23\times\log P^b+5.23\times\log(1/T)\}}$ when the polymerization temperature is from 353.16 K (80°C) to less than 393.16 K (120°C); or

Cmax = 0.050 × Iodine Value (IV) × $10^{\{19.02+1.61\times\log P^b+8.02\times\log(1/T)\}}$ when the polymerization temperature is 393.16 K (120°C) or above.

5. A process for producing a copolymer comprising copolymerizing ethylene, an α-olefin and a non-conjugated polyene in a hydrocarbon solvent, and obtaining a copolymer without removing the catalyst residue from the polymerization solution, wherein the copolymerization is carried out under conditions satisfying the formula (1):

$$\frac{\text{Ethylene concentration in polymerization solution (wt\%)} \times \text{Non-conjugated polyene concentration in polymer (wt\%)}}{\text{Non-conjugated polyene concentration in polymerization solution (wt\%)}} \geq 20 \quad \ldots(1)$$

6. The process for producing an ethylene/α-olefin/non-conjugated polyene copolymer according to claim 5, wherein the copolymerization is carried out with use of a transition metal compound catalyst in a manner such that the unreacted monomers and the hydrocarbon solvent are removed from the polymerization solution whilst the catalyst residue is not removed.

7. The process for producing an ethylene/α-olefin/non-conjugated polyene copolymer according to any one of claims 1 to 6, wherein the removal of the unreacted monomers and the hydrocarbon solvent is performed by evaporation.

8. The process for producing an ethylene/α-olefin/non-conjugated polyene copolymer according to any one of claims 1 to 7, wherein the content of residual unreacted polyene in the copolymer is not more than 500 ppm.

9. A process for producing an

ethylene/propylene/non-conjugated polyene copolymer according to any one of claims 1 to 8, wherein the transition metal compound catalyst is capable of catalyzing copolymerization of ethylene, propylene and a non-conjugated polyene to give an ethylene/propylene/non-conjugated polyene copolymer having an ethylene content of 70 mol% and an iodine value of at least 15, when the copolymerization is carried out under conditions such that the polymerization temperature is 80°C, a reactor is employed which includes a gas phase and a liquid phase, the ethylene and propylene of the gas phase have a combined partial pressure of 0.6 MPa or above, and the non-conjugated polyene of the liquid phase has a concentration of 15 mmol/L or below.

10. The process for producing an ethylene/α-olefin/non-conjugated polyene copolymer according to any one of claims 1 to 9, wherein the transition metal content in the copolymer is not more than 20 ppm.

11. The process for producing an ethylene/α-olefin/non-conjugated polyene copolymer, wherein the transition metal compound catalyst is a transition metal-containing polymerization catalyst comprising:

(A) a transition metal compound represented by the

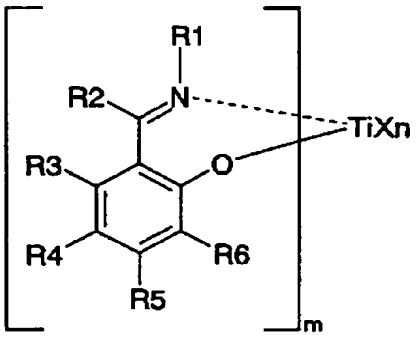
following formula (I); and

(B) at least one compound selected from (B-1) to (B-3):

(B-1) an organometallic compound;

(B-2) an organoaluminum oxy-compound; and

(B-3) a compound which reacts with the transition metal compound (A) to form an ion pair:



... (I)

wherein:

m is an integer of 1 to 4;

R1 to R5, which may be the same or different, are each a hydrogen atom, a halogen atom, a hydrocarbon group, a heterocyclic compound residue, an oxygen-containing group, a nitrogen-containing group, a boron-containing group, a sulfur-containing group, a phosphorus-containing group, a silicon-containing group, a germanium-containing group or a tin-containing group; R6 is a group selected from aliphatic hydrocarbon groups in which the carbon bonded to the phenyl group is a primary, secondary or tertiary carbon, alicyclic hydrocarbon groups in which the carbon bonded to the phenyl

group is a primary, secondary or tertiary carbon, and aromatic groups; and two or more of these substituent groups may be bonded to each other to form a ring;

when m is 2 or greater, two of the groups R1 to R6 may be bonded to each other (with the proviso that the groups R1 are not bonded to each other);

n is a number satisfying a valence of the titanium atom; and

X is a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residue, a silicon-containing group, a germanium-containing group or a tin-containing group, and when n is 2 or greater, plural groups X may be the same or different and may be bonded to each other to form a ring.

12. An ethylene/α-olefin/non-conjugated polyene copolymer comprising ethylene, an α-olefin of 3 to 20 carbon atoms and a non-conjugated polyene, the copolymer being characterized in that:

(i) the Mooney viscosity at 100°C (ML(1+4)100°C) is 5 to 190 or the intrinsic viscosity [η] at 135°C in decalin is 0.02 to 10 dl/g;

(ii) the copolymer contains ethylene in an amount of 50 to 98.9 mol%, the α-olefin of 3 to 20 carbon atoms in an amount of 1 to 49.9 mol%, and the non-conjugated polyene in an amount of 0.1 to 49 mol% based on 100 mol% of the combined ethylene, α-olefin and non-conjugated polyene; and

(iii) the value B indicated below satisfies the formula (2):

$$B \geq (1/a-1) \times 0.26+1 \quad ...(2)$$

wherein $B=(c+d)/(2\times a\times(e+f))$, in which a is an ethylene molar fraction, c is an ethylene/α-olefin dyad molar fraction, d is an ethylene/non-conjugated polyene dyad molar fraction, e is an α-olefin molar fraction, and f is a non-conjugated polyene molar fraction.

13. The ethylene/α-olefin/non-conjugated polyene copolymer according to claim 12, wherein the non-conjugated polyene has a norbornene skeleton.

14. The ethylene/α-olefin/non-conjugated polyene copolymer according to claim 12 or 13, which provides a ^{13}C-NMR spectrum in which the intensity ratio Tαβ/Tαα is 0.015 to 0.15.

15. The ethylene/α-olefin/non-conjugated polyene copolymer according to any one of claims 12 to 14, wherein the

transition metal content in the copolymer is 20 ppm or less.